DRY CELL ANAEROBIC DIGESTION

Municipal Solid Waste to biogas

A Dry Cell Anaerobic Digestion (DCAD) facility consists of several discrete, enclosed bioreactor chambers where the organic waste materials are reduced under anaerobic conditions to produce biogas.

The use of a modular, batch approach maintains stable biogas production, so it may be employed, for example, to produce biogas to fire a boiler or power a gas engine. After processing, the digestate can be converted into compost or used directly as a nutrient-rich fertiliser for agriculture or horticulture, subject to the degree of contamination of the feedstock. Further options for the use of digestate include its conversion into Refuse Derived Fuel (RDF) or biochar.

DCAD is similar to other forms of anaerobic digestion, in that an oxygen free environment must be maintained, at the correct temperature and pH, and bacteria are encouraged to propagate and convert organic materials to methane and carbon dioxide. However, a typical anaerobic digestion system would require the addition of water to the substrate to ensure mixing can take place within the bioreactor. This would apply to both a low-solids (where solids content is typically between 2% and 8%) and a high-solids reactor (where solids content is in the range of 35%). The Organics DCAD is termed “dry cell” as it does not require the direct pre-mixing of water to the organic waste being treated. It typically operates at above 35% dry matter.

COMPONENTS INVOLVED IN A WASTE-TO-ENERGY SYSTEM USING A DCAD

Front-end processing

Multiple batch anaerobic digestion

Ammonia control

Hydrogen sulphide control

Biogas pumping equipment

Biogas processing systems

BioCNG, burners and/or power generation

ISO 14001

ISO 9001 REGISTERED FIRM

KEY FEATURES

FROM THE RECEPTION HALL TO BIOGAS - A TURNKEY SOLUTION

MINIMAL FRONT END PROCESSING

BATCH TECHNOLOGY WITH LIMITED PARASITIC LOAD

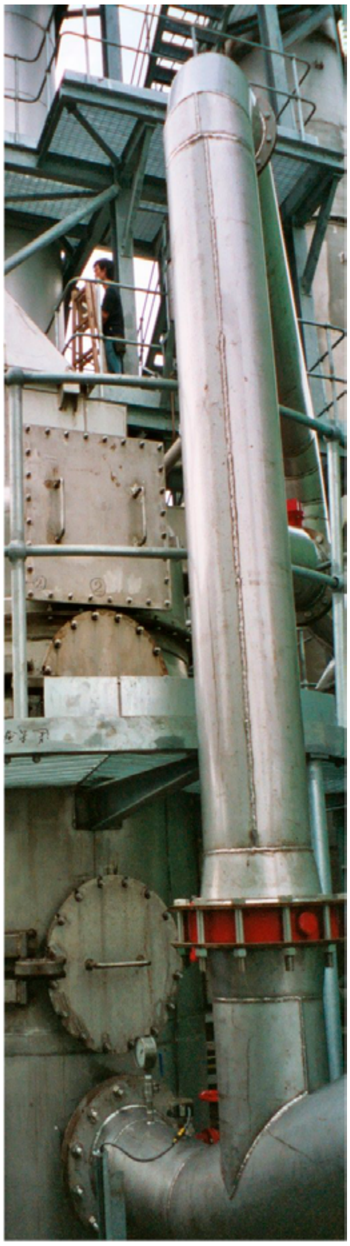
CONVERT THE ORGANIC FRACTION OF MSW TO COMPOST

PASS ONLY INERT WASTE TO LANDFILL

ABLE TO ACCEPT A VARIABLE WASTE COMPOSITION

SIMPLE AND RELIABLE

GREEN HOUSE REDUCTIONS



WASTE MANAGEMENT

The management of domestic waste streams is currently undergoing fundamental change in many countries around the world.

Amongst one of the prime options for consideration is that of recovering energy from municipal solid waste at the point of receipt, prior to disposal, whilst at the same time reducing waste stream volumes.

Technologies that can achieve these objectives include recycling followed by anaerobic digestion, direct combustion, pyrolysis, or gasification. The process presented in this datasheet addresses the opportunity afforded by the use of anaerobic digestion, employing dry cell technology.

In the design of this system, particular emphasis has been given to factors relating to its application, such as waste composition and contaminants. A landfill site is itself a large batch reactor, where anaerobic digestion occurs in a largely uncontrolled and fortuitous manner. The dry cell reactor is rather like a series of small landfill sites, more carefully controlled to speed up the degradation process. Instead of taking ten years to stabilise, a dry cell reactor will designed to stabilise, typically in thirty days.

The result is a compact landfill site replacement, with the production of viable quantities of both biogas and compost, entailing a minimum of waste processing, either at the front-end or post-digestion.

DRY CELL ANAEROBIC DIGESION

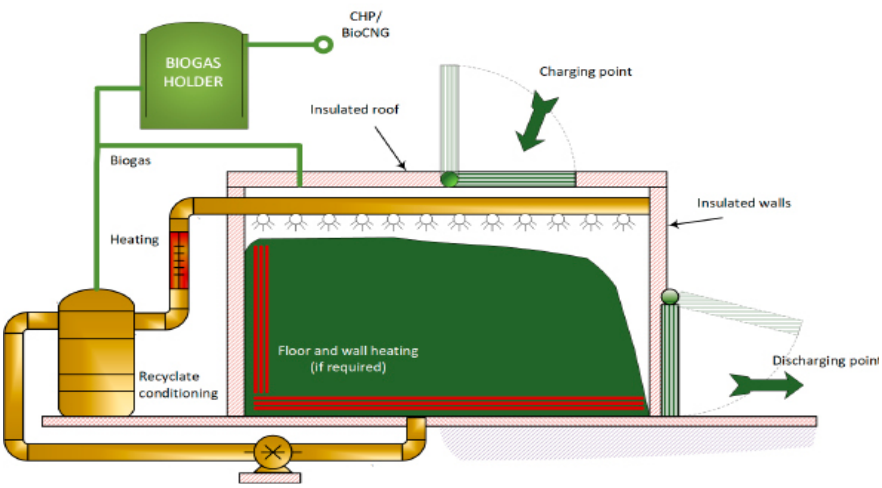
A dry cell anaerobic digestion facility will consist of multiple batch bioreactor units, in each of which the organic fraction of municipal solid waste is digested under anaerobic conditions to produce biogas.

The contents of each cell are fully sealed in a reinforced concrete container to prevent the ingress of air and the egress of biogas. The cells are sized to promote efficient processing of the feedstock, as well as to provide easy entry for conveyor belt top-fill and ground level access for front-end loaders during extraction of spent materials.

The biology required to support anaerobic digestion is managed and maintained in recirculating fluids. Continuous seeding and flushing with bacteria occurs during the anaerobic digestion process, through the passage of recyclate over the internal surface of the waste mass.

Dry cell anaerobic digestion does not require waste mass mixing. The process is managed by the passage through the waste of optimised flows of seed materials, at the correct acid and nutrient ratios, pH and temperature. Where necessary ammonia concentrations are also managed.

The recycled liquids are exacted from the base of each cell, and recycled, on an individual cell basis, through a water treatment facility. The temperature of the recyclate liquid is controlled using process heat, although this use of heat is thermally optimised.



OPERATIONAL PARAMETERS

(Based upon 100 dry tpd MSW)

Typical solids content:
40%

Organics content:
60%

Cell capacity:
2000 cubic metres

Number of cells:
3

Full cycle time:
42 days/cell

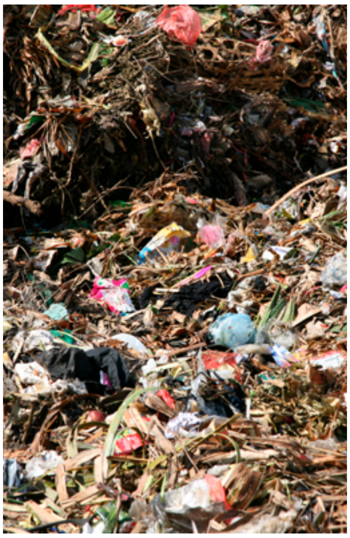
Fuel gas produced:
c. 8200 Nm3/day methane

Methane percentage:
60%

Compost production:
30 tons per day

Standby flare capacity:
750 Nm3/hr

Power production:
1.2 MWe



IMPORTANT PARAMETERS

For dry cell anaerobic digestion to proceed correctly there are a number of parameters that need to be maintained within certain limits. These include:

- waste composition
- moisture content and form of solids
- biomethane potential

Being confident concerning the waste composition is of primary importance. When tackling a municipal solid waste situation, this will normally mean undertaking a full waste characterisation study. Feedstocks other than municipal waste may be less challenging, with a lesser range of components. Of particular importance will be to determine the type and average percentage of organic material in the waste stream. Waste composition can vary enormously from country to country and location to location within specific countries.

Feedstock composition affects the make-up of the product gas and the amount and type of digestate that will result. Biomethane potential testing can assist in defining realistic performance expectations. Uniform feedstock composition is preferable, although rarely achievable with municipal solid waste systems, as this ensures that product gas composition will remain stable and provide less difficulty for subsequent usage technologies, such as combustion within an internal combustion engine or cleaning the biogas for use as BioCNG.

As moisture content increases the method of recyclate management will change. Coupled with this parameter is the nature of the solids. It is beneficial for the waste to contain a small percentage of relatively inert materials, such as wood, plastic, and textiles. This material provides pathways for the passage of recyclate. If the waste is particularly wet it may be necessary to add in structure, in the form of random packing. Such added packing will be removed post digestion through a rotating screen.

DIGESTATE

Digestate, comprised of liquid and solids, is the residual material left after the digestion process is completed. The liquid and solid fractions are often separated and handled independently, as each has a potential value that may be achieved with varying degrees of additional processing.

With appropriate treatment, both the solid and liquid portions of digestate can be used in many beneficial applications, such as animal bedding (solids), nutrient-rich fertiliser (liquids and solids), a foundation material for bio-based products (e.g., bioplastics), organic-rich compost (solids), and/or simply as soil amendment (solids), the latter of which may include the farm spreading the digestate on the field as fertilizer. Digestate products can be a source of revenue or cost savings and are often pursued to increase the financial and net-environmental benefit of such a project.

Organic wastes used as feedstocks for biogas production contain a number of macronutrients (nitrogen, phosphorus, potassium, calcium, sulphur, and magnesium) as well as micronutrients (boron, chlorine, manganese, iron, zinc, copper, molybdenum, and nickel. During the digestion process, the nutrients are released and concentrated in the residue, making the digestate a viable fertiliser containing most of the nutrients in plant-available form. It has been reported that this residue from biogas production can result in similar or even better crop yields than obtained by the use of commercial fertilisers.

Where necessary, it may be a requirement for front-end processing to remove items that would lead to the excessive presence of heavy metals (cadmium, lead and mercury) which in higher concentrations are toxic to plant growth. The most suitable feedstocks for digestate to be used as a fertiliser are animal manures, crops, the organic fraction of MSW, vegetable by-products and residues, and wastes from agriculture, horticulture, and forestry.

ADVANTAGES

- Rapid conversion of biomass waste into energy
- Waste reduction to digestate, a valuable by-product
- Maximise existing landfill capacity
- Conversion of a waste-stream liability into a resource
- Integrated management options to combine wet wastes and dry wastes
- Efficient biogas production
- Low complexity and low parasitic load
- Minimal front-end processing requirements
- Can be located close to the source of waste, thus reducing transport distances and costs
- Plant configuration allows a wide range of waste types to be passed through the anaerobic reactor
- Gas management systems ensure smooth operation of energy generation plant
- Options for preparation of digestate to be used as a fertiliser

WASTE TO ENERGY

There are many types of organic waste stream produced by both industry and society in general. Such waste is at present a public liability, causing difficulties for transfer, handling and long-term disposal.

The major repository for organic waste is presently the landfill site, although society at large is moving inexorably to minimise the use of this technology.

Such waste may be broadly categorised as both dry and wet waste. The great advantage of the dry cell approach for such wastes is that the moisture content can be accommodated in the design and operation of the process. Whereas many other forms of anaerobic digester require either homogeneous feedstock or tightly managed pre-processing, the DCAD is tolerant to wide variety of waste types. With a typical retention time of several weeks, a high conversion to biogas can be reliably achieved.

The Organics DCAD system is designed to accept a broad range of organic waste consistencies. This is an essential pre-requisite for systems designed to take municipal solid waste.

Disposal by means of dry cell anaerobic digestion will convert waste to energy and reduce disposal requirements.

ADVANTAGES OF DCAD

Dry cell anaerobic digesters have a number of advantages for use in advanced biomass power systems, including reduced emissions, increased efficiencies, and flexibility for use with a variety of biomass feedstocks.

DCADs can take advantage of biomass feedstocks unsuitable for other forms of anaerobic digestion. Because of the robust nature of the processes involved, the sensitivity to poisoning is largely eliminated.

Being essentially relatively simple, the construction time to bring a project up to full operational capacity can be relatively short.

The Organics dry cell digestion facilities achieve elevated and steady biogas production through the fermentation of various solid organic feedstocks, such as garden waste, varied green wastes, source separated organics, municipal solid waste, animal litter and other low moisture content organic wastes, whilst requiring comparatively low parasitic loads to operate.

The viably economic and environmentally sound creation of clean energy marks this technology out and differentiates to from other forms of organic waste management.

For further information on the possible use of this technology please contact your nearest Organics office

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